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New Species of the Genus *Pheretima* s. lat. (Annelida, Oligochaeta, Megascolecidae) from Tokyo, Japan—Species with Manicate Intestinal Caeca

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Abstract In the first series of the study on the genus *Pheretima* s. lat. (family Megascolecidae) collected from Tokyo, a group of the species with manicate intestinal caeca is dealt with and 11 new species are described here: *Pheretima conjugata*, *Ph. aokii*, *Ph. okutamaensis*, *Ph. bigibberosa*, *Ph. bimaculata*, *Ph. purpurata*, *Ph. silvatica*, *Ph. surcata*, *Ph. verticosa*, *Ph. florea* and *Ph. striata*.

Key words: Megascolecidae, *Pheretima* s. lat., new species, Tokyo.

Introduction

The earthworm family Megascolecidae is composed of about 760 species mainly distributed in Asia (Easton, 1979), and most of 155 species from Japan are indigenous to Japan (Kobayashi, 1941). It took a long time for the author to collect more than 70 species mainly in the whole area of Tokyo. It is surprising that about 50 species, more than 70% of them, are undescribed species. The author intends to describe these species and, in the first step, to deal with the members of the genus *Pheretima* s. lat. The species of the genus in question are classified chiefly on their morphology of intestinal caeca, the number of pairs of spermathecal pores, the genital markings, the genital glands, the external markings, the spermathecae and so on, that are closely related with their ecological strategy. The type series of the new species are deposited in the National Science Museum, Tokyo (NSMT).

Genus *Pheretima* Kinberg, 1867 (s. lat.)

Diagnosis. Body cylindrical, varying in size. Setae numerous, regularly arranged around each segment. Clitellum annular, situated in XIV–XVI. Male pores paired, occasionally single, found on one side, opening on the surface of XVIII (rarely XIX), but rarely absent. Female pore single, situated in XIV. Spermathecal pores small (rarely large), usually paired (bithecal), occasionally single on one side (monothecal) in 4/5–8/9. Genital markings present or absent, neighbouring on male pore or spermathecal pore, or both, variable in the number and situation. Testes paired, in X, XI. Seminal vesicles paired, in XI, XII. Ovaries paired, in XIII. Spermathecae (ampulla with or without diverticulum) paired, in V–IX, occasionally simple

on one side, or lacking. Copulatory pouches absent (rarely present). Prostatic glands racemose, occasionally single on one side or lacking. Genital glands present (in the case genital marking present) or absent (in the case genital marking absent). Gizzard found in 7/8 and 9/10. Oesophageal pouches absent. Intestine usually beginning from XV, rarely XIV or XVI. Intestinal caeca present, originating in XXVII (rarely XXVI). Dorsal pore beginning from 12/13, occasionally from 11/12 or 13/14. Septa absent in 8/9 and 9/10. Lateral hearts paired in XI–XIII and single in X. Nephridial tubules absent.

Remarks. Since Kinberg (1867) established the two genera *Pheretima* and *Amyntas* in the family Megascolocidae, the former genus was divided into several subgenera by Cognetti (1912), Michaelsen (1928, 1934) and through the elevation of them to the genus rank by Sims and Easton (1972), rearrangement by Easton (1979) and addition of one new genus by Easton (1982), they were finally consisted of the ten genera including the genus *Amyntas*. However, the classification mentioned above seems to be not satisfactory and the author prefer, for the time being, to use only the genus *Pheretima* s. lat. for the Japanese species of this group of earthworms. More appropriate classification of the group must be done after the completion of more intensive study on the species in Japan and other countries in Asia, considering the morphology of intestinal caeca as most important character.

***Pheretima conjugata* sp. nov.**

[New Japanese name: Ittsui-mimizu]

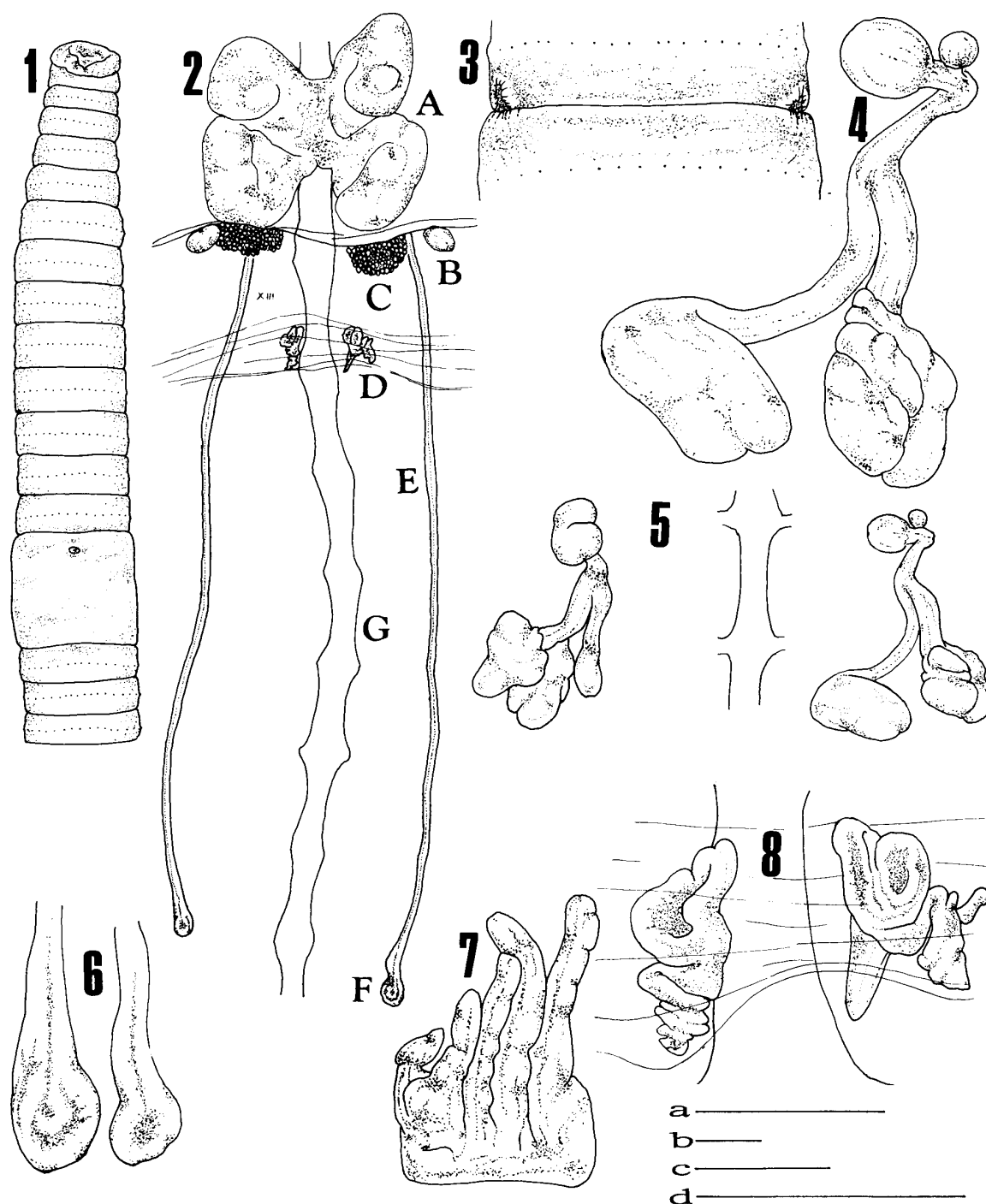
(Figs. 1–8)

Description. Body. Length 90–140 mm, width 4.4–5.0 mm. Number of segments 65–83. Light greenish brown dorsally, yellowish brown ventrally.

External characters. One pair of spermathecal pores large, situated in furrow 6/7, in ventro-lateral side, separated by a distance of ca. 2/5 body circumference, variable in the number (Out of the nine individuals, two have a pair of spermathecal pores, four in one side and three absent). Genital marking absent. Male pore absent. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 45–51 in segment VII, 45–52 in segment XX.

Internal characters. Maniccate intestinal caeca each with 4–5 diverticula, originating in segment XXVII, extending anteriorly for 3–4 segments. Intestine begins in XV. Genital gland absent. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. One pair of spermathecae large, in segment VII. Ampulla and diverticulum consisting of a duct and a large saccular. Seminal vesicles extending to the dorsal line on segments XI–XII. Prostata absent.

Material examined. Holotype (NSMT-An 239) and 4 paratypes (NSMT-An 240): From litter and surface soil under a mixed forest of evergreen and deciduous



Figs. 1–8. *Pheretima conjugata* sp. nov. Holotype (NSMT-An 239). 1: Ventral view of anterior body. 2: Dissection of the reproductive system in dorsal view. (A; seminal vesicles, B; ovisac C; ovary, D; oviduct, E; vas deferens, F; distal typhlosole, G; nerve cord). 3: Spermathecal pores on intersegment 6/7. 4: Spermathecae. 5: A pair of a spermathecae in segment VII in dorsal view. 6: Distal typhlosoles of vas deferens. 7: Intestinal caecum. 8: A pair of oviducts in segment XIV. (Scale bars. a; 10 mm for 1, b; 1 mm for 2–3, 5, 7, c; 1 mm for 4, d; 1 mm for 6)

trees, Nippara Valley, 14-IX-1985, K. Ishizuka. Other specimens examined: 6 exs. with same data as the type series.

Remarks. The new species closely resembles *Pheretima irregularis* (Goto et Hatai, 1898), but is distinguishable from the latter species by (1) only one pair of spermathecal pores, (2) body coloration of greenish brown, and (3) absence of genital markings and genital glands.

***Pheretima aokii* sp. nov.**

[New Japanese name: Aoki-mimizu]

(Figs. 9-18)

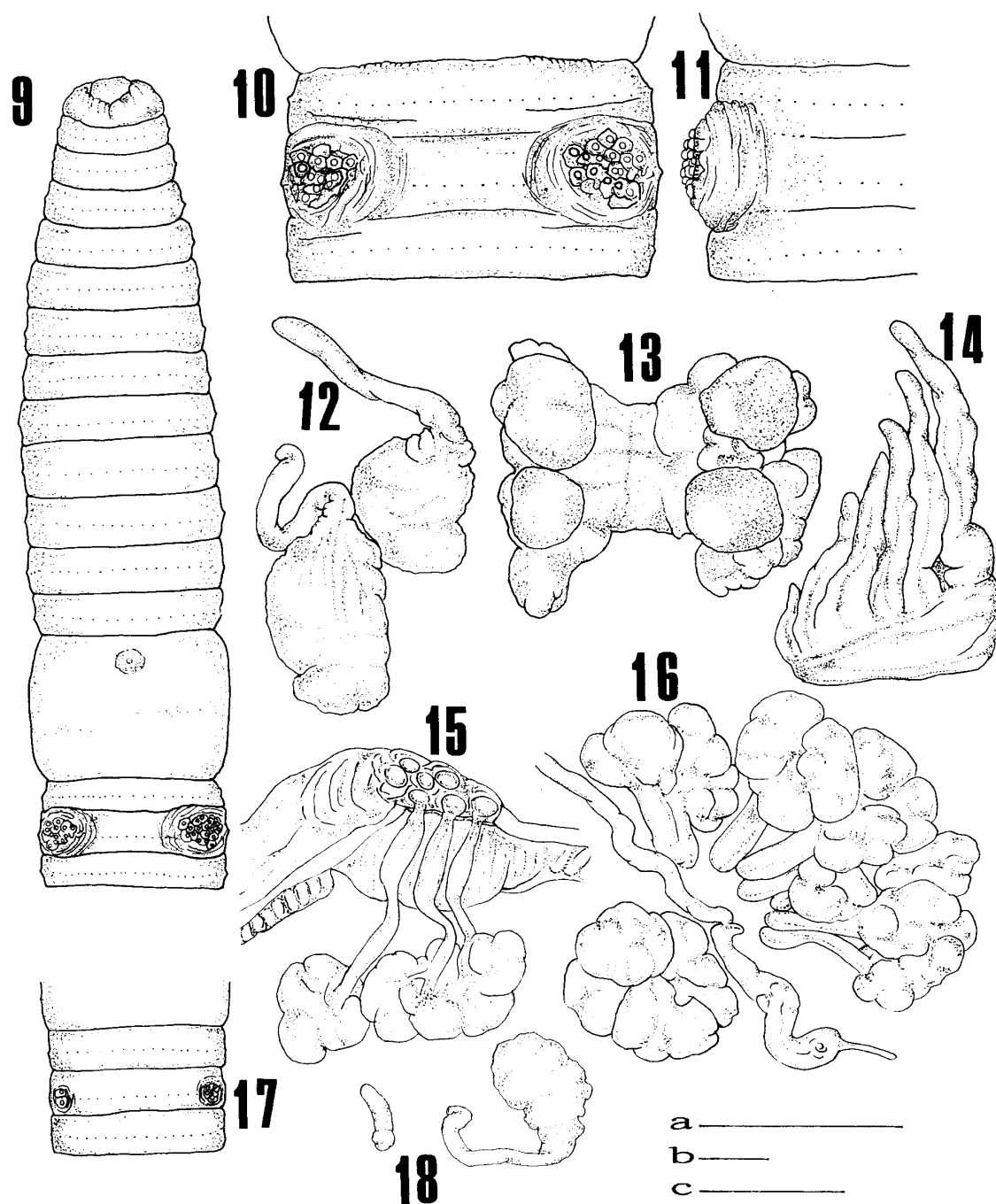
Description. Body. Length 60-125 mm, width 3.5-6 mm. Number of segments 70-105. Reddish brown dorsally, yellowish grey ventrally.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 2/5 body circumference. Genital markings in two large clusters, each consisting of several pieces to a dozen pieces of genital papillae on segment XVIII. Male pore absent. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV-XVI. Setal number 46-48 in segment VII, 48-55 in segment XX.

Internal characters. Manicate intestinal caeca each with 5-6 diverticula, originating in segment XXVII, extending anteriorly for 4-5 segments. Intestine begins in XV. Genital glands on segment XVIII as a dozen pieces of simple duct bearing a capsulogenous gland, each consisting of a duct and a distal vesicle, associated with genital papilla. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Two pairs of spermathecae on segments VII-VIII, each single. Ampulla consisting of a shovel-shaped pouch and a duct, frequently poorly developed and lacking. Diverticulum absent. Seminal vesicles extending to the dorsal line on segments XI-XII, rarely extending to X-XIV in developed individuals. Prostata absent.

Material examined. Holotype (NSMT-An 241) and 5 paratypes (NSMT-An 242): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Higashikurume City, 18-VI-1981, K. Ishizuka. Other specimens examined: 13 exs. Institute for the Nature Study, National Science Museum, Meguro, 18-VII-1985; 43 exs. with same data as the type series; 68 exs. Houya City, 21-VII-1981; 26 exs. Rikugien, 25-VII-1983; 18 exs. Meiji-jingu, 2-VIII-1983; 27 exs. Asukayama Park, 25-VIII-1983. All the specimens were collected by the author.

Remarks. The new species resembles *Pheretima hilgendorfi* Michaelsen 1892, but is distinguishable from the latter species by (1) the small body length, (2) genital markings situated posterior to clitellum, each consisting of several pieces to a dozen pieces of genital papillae at the position where the male pores exist on segment XVIII, and (3) the absence of diverticulum. The new species is distinguishable from all the other congeneric species by lacking male pores (the male pores are entirely ab-



Figs. 9–18. *Pheretima aokii* sp. nov. 9–16: Holotype (NSMT-An 241), 7–18: Paratype (NSMT-An 242). 9: Ventral view of anterior body. 10: Genital papillae on segment XVIII. 11: Lateral view genital papillae of segment XVIII. 12: Spermathecae. 13: Dorsal view of seminal vesicles. 14: Intestinal caecum. 15: A cross sectional view in segment XVIII, Genital glands associated with genital papillae. 16: Capsulogenous glands (simple duct type) on segment XVIII and distal typhlosole of vas deferens. 17: Genital papillae on segment XVIII. 18: Spermathecae of undeveloped (a variable spermathecae). (Scale bars. a; 5 mm for 9, 17–18, b; 1 mm for 10–14, c; 1 mm for 15–16)

sent in 207 individuals from Tokyo).

***Pheretima okutamaensis* sp. nov.**

[New Japanese name: Shimachibi-mimizu]

(Figs. 19–28)

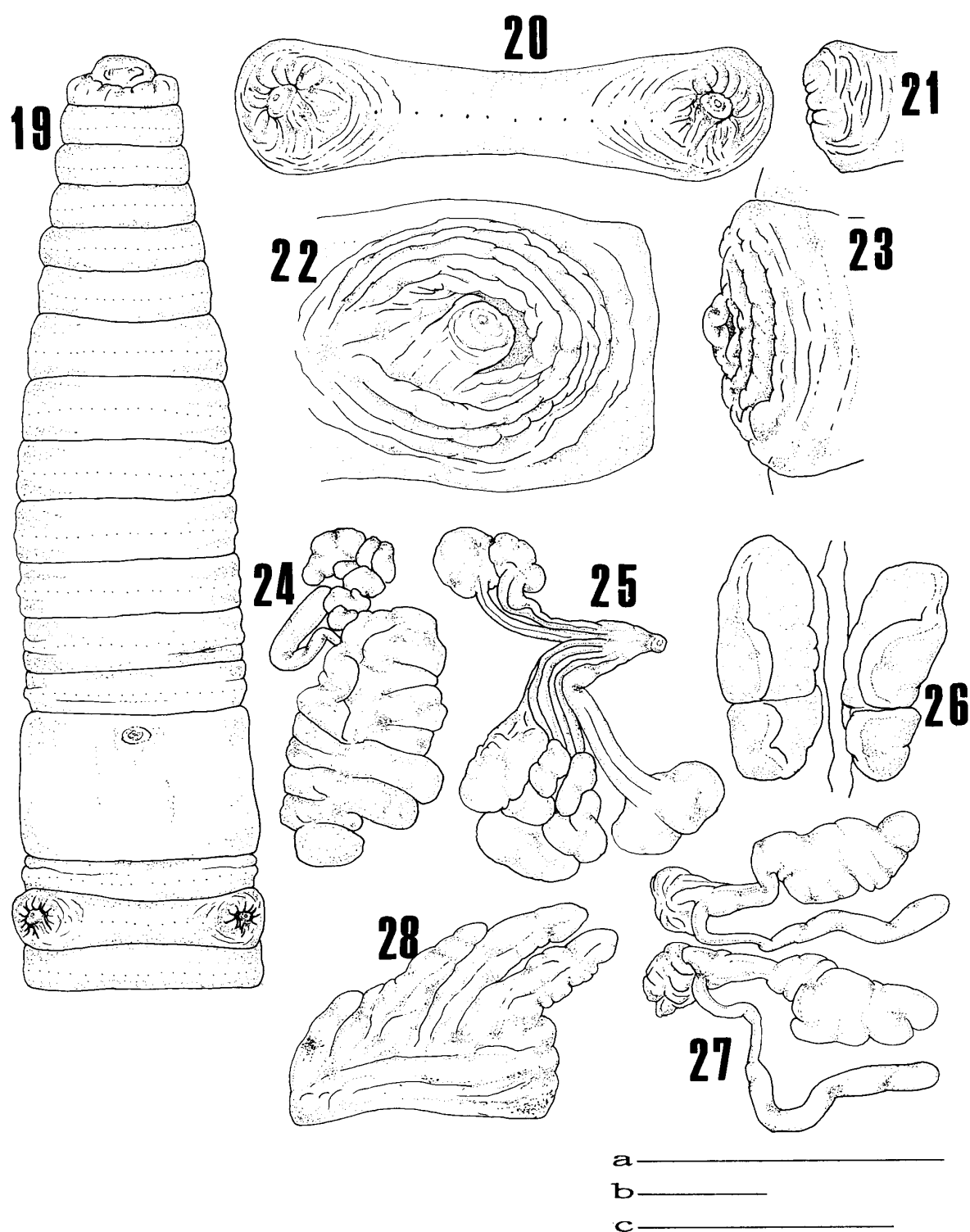
Description. Body. Length 45–70 mm, width 3.0–3.3 mm. Number of segments 70–86. Reddish brown dorsally, with light yellowish setal line, yellowish white ventrally. External appearance similar to that of *Eisenia foetida* Savigny, 1826.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in the ventro-lateral sides separated by a distance of ca. 1/2 body circumference. Genital markings large, situated on and covering male pore, paired, therefore genital papillae are often mistaken for male pores, but by cutting open the body these two can be distinguished and occasionally absent. Male pores large, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 40–52 in segment VII, 40–48 in segment XX.

Internal characters. Manicate intestinal caeca each with 3–4 diverticula, originating in segment XXVII, extending anteriorly for 3–4 segments. Intestine begins in XV. Genital glands on segment XVIII as complex duct bearing several capsulogenous glands and, a stout duct, which has a dozen pieces of large capsulogenous glands and occasionally absent. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Spermathecae large, two pairs on segments VII–VIII. Ampulla consisting of a shovel-shaped pouch and a stout duct. Diverticulum consisting of a narrow duct and a long distal sausage-shape welling or twisted tube. Basis of spermathecal duct covered with strong membrane and firmly fixed to body wall. Seminal vesicles very large, extending on segments XI–XIV. Prostata very large, extending on segments XVII–XXII, corresponding to male pores.

Material examined. Holotype (NSMT-An 243) and 2 paratypes (NSMT-An 244): From litter and surface soil under a mixed forest of evergreen and deciduous trees Nippara Valley, 8–VIII–1981, K. Ishizuka. Other specimens examined: 13 exs. with same data as type series; 5 exs. Mt. Tsukiyomi, 8–VIII–1981; 8 exs. Mt. Mitake, 5–VIII–1983; 6 exs. Ohtanba Valley, 30–VIII–1983; 9 exs. Mizune Valley, 7–IX–1983. All the specimens were collected by the author.

Remarks. Dorsal face is reddish brown but setal line makes a yellowish white line on it, so the external appearance is similar to that of *Eisenia foetida* Savigny, 1826 (family Lumbricidae), but is distinguishable from the latter species by the characters of the family Megascolecidae. Internal genital organs are developed into large forms, therefore segments VII–XII are swollen. The new species is distinguishable from all the other congeneric species by the large male pore covered with genital papillae. Genital papillae are therefore often mistaken for male pores, but these two



Figs. 19–28. *Pheretima okutamaensis* sp. nov. Holotype (NSMT-An 243). 19: Ventral view of anterior body. 20: Male pores and genital markings, makes a cover over male pores on segment XVIII. 21: Lateral view of segment XVIII. 22: One side male pore and genital marking on segment XVIII. 23: Lateral view of segment XVIII. 24: Prostate gland with duct and capsulogenous glands. 25: Capsulogenous glands (complex duct type). 26: Dorsal view of seminal vesicles. 27: Spermathecae. 28: Intestinal caecum. (Scale bars. a; 5 mm for 19, 24, 26–27, b; 1 mm for 20–21, 25, 28, c; 1 mm for 22–23)

can be distinguished by dissection.

***Pheretima bigibberosa* sp. nov.**

[New Japanese name: Tanimima-mimizui]

(Figs. 29–37)

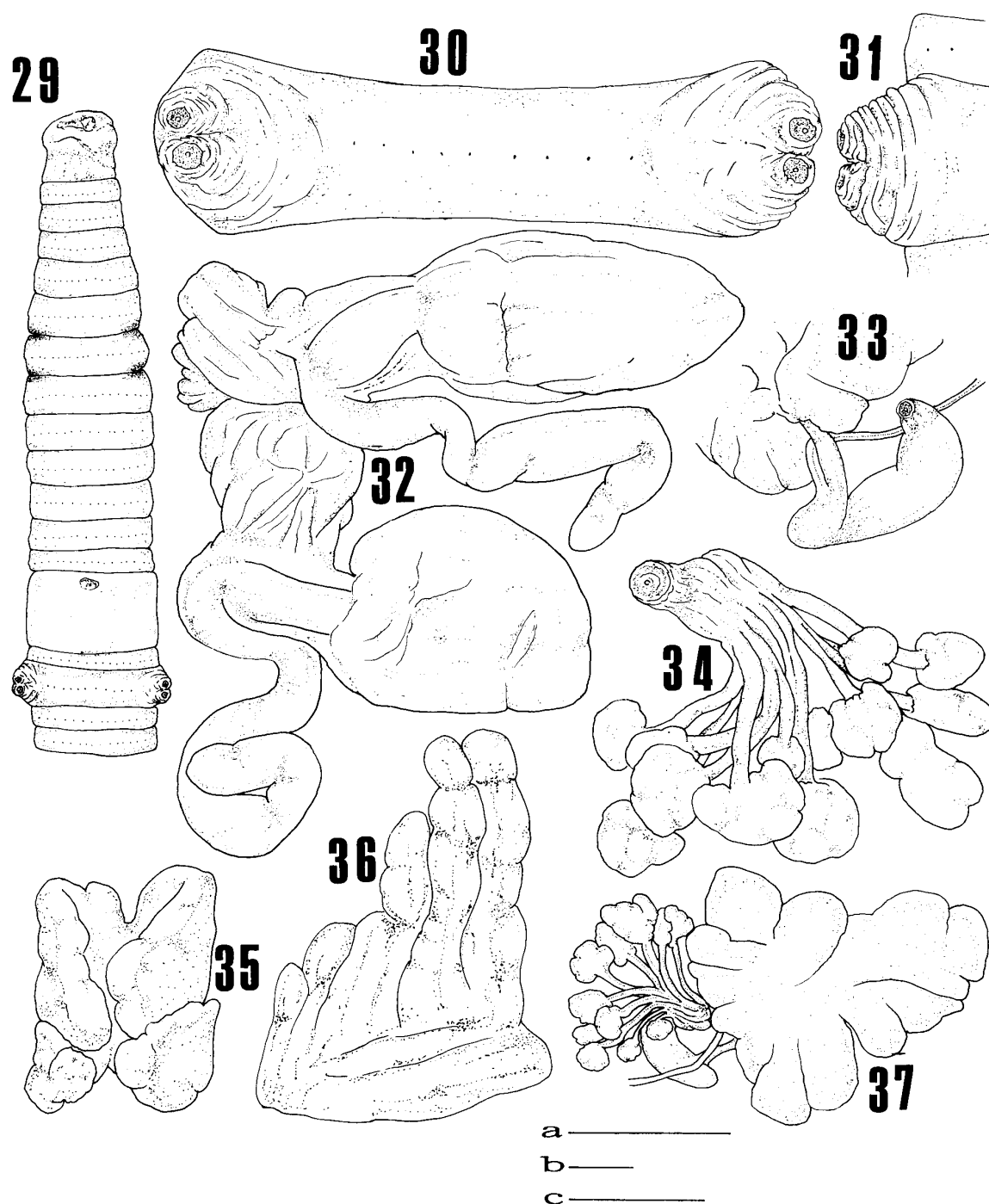
Description. Body. Length 55–73 mm, width 3.0–3.8 mm. Number of segments 70–86. Reddish brown dorsally, greyish white ventrally.

External characters. Two pairs of spermathecal pores large, torn sideways, situated in furrows 6/7/8, in ventro-lateral sides, separated by a distance of ca. 1/2 body circumference. Genital markings large, projecting from the surface, paired, on segment XVIII, situated close to male pore and similar in shape and size to the latter. Male pore projecting from the surface, sucker type, on segment XVIII. Male pores and genital markings quite similar in shape and these two arranged side by side with a setal line between them. Male pores and genital markings not distinguishable in external form each other. Male pores situated at presetal line (in front of the setal line), separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13 rarely in 11/12. Clitellum including segments XIV–XVI. Setal number 42–52 in segment VII, 46–48 in segment XX.

Internal characters. Maniccate intestinal caeca each with 4–6 diverticula, originating in segment XXVII, extending anteriorly for 3–4 segments. Intestine begins in XV. Genital glands consisting of complex duct bearing several capsulogenous glands on segment XVIII, with stalked glands associated with genital sucker. One genital sucker with several pieces of large capsulogenous glands fixed to body wall. Septa absent in 8/9/10, slightly thickened in 5/6/7/8 delicate in 10/11/12/13/14. Two pairs of spermathecae large, on segments VII–VIII. Ampulla consisting of a shovel-shaped pouch and its duct stout. Diverticulum consisting of a stout duct and a distal sausage like swelling. The basis of spermathecae duct covered with strong membrane and firmly fixed to body wall. Seminal vesicle large and well developed, extending on segments X–XV. Prostata large, extending on segments XVII–XXII, corresponding to male pore.

Material examined. Holotype (NSMT-An 245) and 5 paratypes (NSMT-An 246): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Mitake, 29–VII–1980, K. Ishizuka. Other specimens examined: 6 exs. with same data as type series.

Remarks. The new species resembles *Pheretima heterogens* Chen et Hsü, 1975, but is distinguishable from the latter species by (1) two pairs of spermathecal pores and (2) the maniccate intestinal caeca. The position of male pore at presetal line cannot be seen in all the other congeneric species of the genus *Pheretima*.



Figs. 29–37. *Pheretima bigibberosa* sp. nov. Holotype (NSMT-An 245). 29: Ventral view of anterior body. 30: Male pores and genital marking on segment XVIII. 31: Lateral view of segment XVIII. 32: Spermathecae. 33: Prostate gland and prostate gland with duct, vas deferens. 34: Capsulogenous glands (complex duct type). 35: Dorsal view of seminal vesicles. 36: Intestinal caecum. 37: Prostate gland and capsulogenous glands. (Scale bars. a; 5 mm for 29, b; 1 mm for 35, 37, c; 1 mm for 30–34, 36)

***Pheretima bimaculata* sp. nov.**

[New Japanese name: Hanmon-mimizu]

(Figs. 38–45)

Description. Body. Length 40–70 mm, width 3.0–4.5 mm. Number of segments 80–90. Light reddish brown dorsally, greyish white ventrally.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/2 body circumference. Genital markings consisting of genital papillae of two forms, in one form papillae arranged presetal on segments IX–X; in an other form several pieces to a dozen several pieces of genital papillae put together presetal on segments XVIII and XIX. Male pores simple and medium-sized porophores, superficial on segment XVIII, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Setal number 44–48 in segment VII, 44–50 in segment XX. Clitellum including segments XIV–XVI.

Internal characters. Maniculate intestinal caeca, each with 5–7 diverticula, originating in segment XXVII, extending anteriorly in segments 4–5. Intestine begins in XV. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Two pairs of spermathecae on segments VII–VIII. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum long convoluted tube. Prostata very large on segments XVI–XXII, corresponding to male pore. Genital glands consisting of simple duct bearing a capsulogenous gland with stalked glands associated with genital papillae. Seminal vesicle large, on segments XI–XII.

Material examined. Holotype (NSMT-An 247) and 5 paratypes (NSMT-An 248): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Daibosatsu-tôge, 6–VIII–1980, K. Ishizuka. Other specimens examined: 4 exs. with same data as type series; 2 exs. Mt. Daibosatsu-tôge, 26–VII–1981. All the specimens were collected by the author.

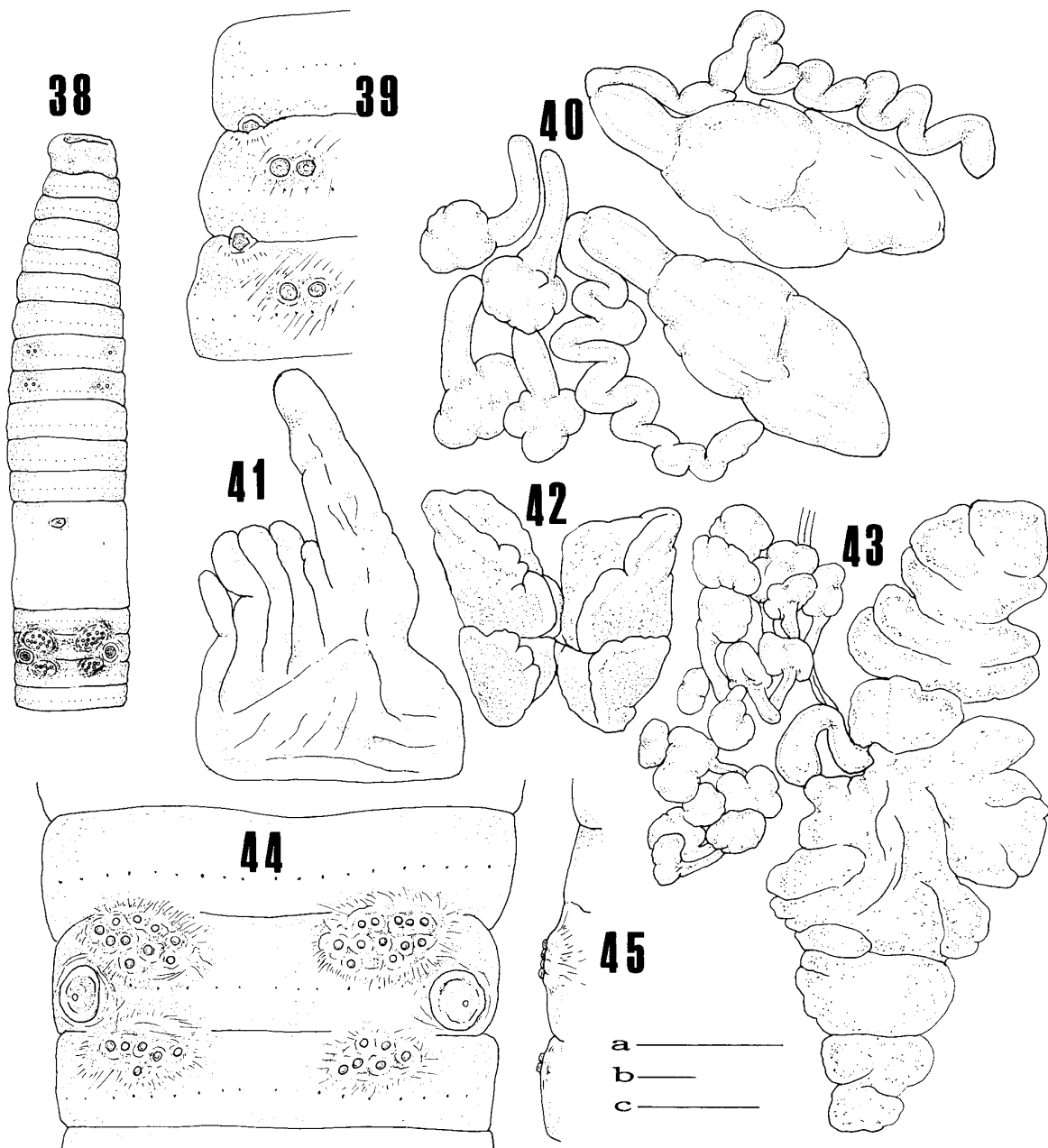
Remarks. The new species resembles *Pheretima tappensis* Ohfuchi, 1935, but is distinguishable from the latter species by (1) the small body length 40–70 mm, and (2) the shovel-shaped ampulla. The new species is distinguishable from all the other congeneric species by having a pair of aggregations each consisting of several pieces of genital papillae on segments XVIII–XIX (the form of these aggregations of genital papillae are peculiar to the new species and are easily distinguishable with the naked eye).

***Pheretima purpurata* sp. nov.**

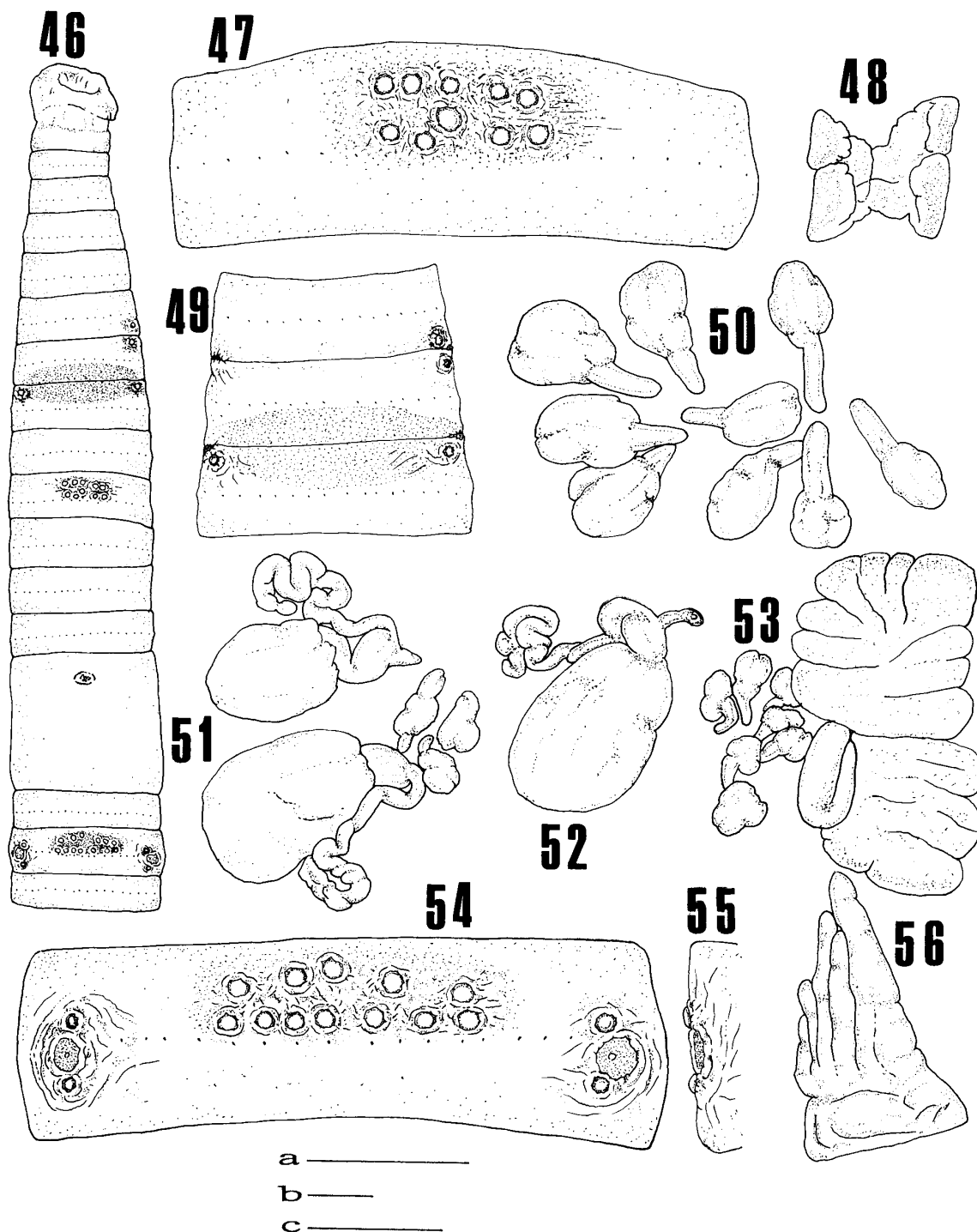
[New Japanese name: Nijihiro-mimizu]

(Figs. 46–56)

Description. Body. Length 65–105 mm, width 4.0–4.5 mm. Number of seg-



Figs. 38–45. *Pheretima bimaculata* sp. nov. Holotype (NSMT-An 247). 38: Ventral view of anterior body. 39: Spermathecal pores and genital papillae one side on segments VI–VIII (ventral view). 40: Spermathecae and capsulogenous glands (simple duct type). 41: Intestinal caecum. 42: Dorsal view of seminal vesicles. 43: Prostate gland and capsulogenous glands (simple duct type). 44: Male pores and genital papillae on segment XVIII. 45: Lateral view of segment XVIII. (Scale bars. a; 5 mm for 38, b; 1 mm for 42, c; 1 mm for 39–41, 43–45)



Figs. 46–56. *Pheretima purpurata* sp. nov. Holotype (NSMT-An 249). 46: Ventral view of anterior body. 47: Genital papillae on segment X (Ventral). 48: Dorsal view of seminal vesicles. 49: Spermathecal pores and genital papillae, external marking (brown patch on segments VII–VIII), ventral view. 50: Genital glands (capsulogenous glands) on segment X, expanded each other expanded. 51: Spermathecae and capsulogenous glands (simple duct type). 52: Spermathecae. 53: Prostate gland and capsulogenous glands. 54: Male pores and genital papillae on segment XVIII. 55: Lateral view of segment XVIII. 56: Intestinal caecum. (Scale bars. a; 5 mm for 46, 48, b; 1 mm for 49, 51–53, 56, c; 1 mm for 47–48, 50, 54–55)

ments 80–91. Reddish violet brown dorsally, greyish white ventrally. The reddish violet brown dorsal face gives out the luster of a rainbow. Adjacent male pore on segment XVIII.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/2 body circumference. Genital markings consisting of two kinds genital papillae; one kind exists, preclitellar slightly lateral to line of spermathecal pores, presetal on segments VI–VIII, anterior and posterior to male pores on segment XVIII; an other kind put together presetal on segments X and XVIII. External markings, brown-colored patch present in furrow 6/7 and almost reach setal line. Male pores simple, on medium-sized porophores, superficial on segment XVIII, separated by a distance of ca. 1/3 body circumference. Female pore single, midventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 44–52 in segment VII, 44–52 in segment XX.

Internal characters. Manicate intestinal caeca each with 5–6 diverticula, originating in segment XXVII, extending anteriorly for 4–5 segments. Intestine begins in XV. Genital glands consisting of simple duct bearing a capsulogenous gland with stalked glands associated with genital papillae. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Two pairs of spermathecae on segments VII–VIII. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum consisting of a convoluted tube and a duct. Seminal vesicles extending to dorsal line on segments XI–XII, almost extended to X–XIV in well developed individuals. Prostata on segments XVI–XX, corresponding to male pore.

Material examined. Holotype (NSMT-An 249) and 5 paratypes (NSMT-An 250): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Mitake, 7–VII–1988, K. Ishizuka. Other specimens examined: 6 exs. with same data as type series; 10 exs. Mt. Mitake, 31–VIII–1981; 3 exs. Mt. Takao, 31–VII–1981; 7 exs. Itukaichi-city, 8–VIII–1981. All the specimens were collected by the author.

Remarks. The new species is distinguishable from all the other congeneric species by (1) both the external markings and the genital markings ventrally, which are more abundant than in the related species, (2) two kinds of genital markings: one separated from one another, the other put together, and (3) brown-colored patch found on intersegmental 6/7, almost reaching setal line. This distinctive external color marking can not be seen in any other species of the genus *Pheretima*. The reddish, violet brown dorsal face giving out the luster of a rainbow is one of the important criteria to distinguish this species.

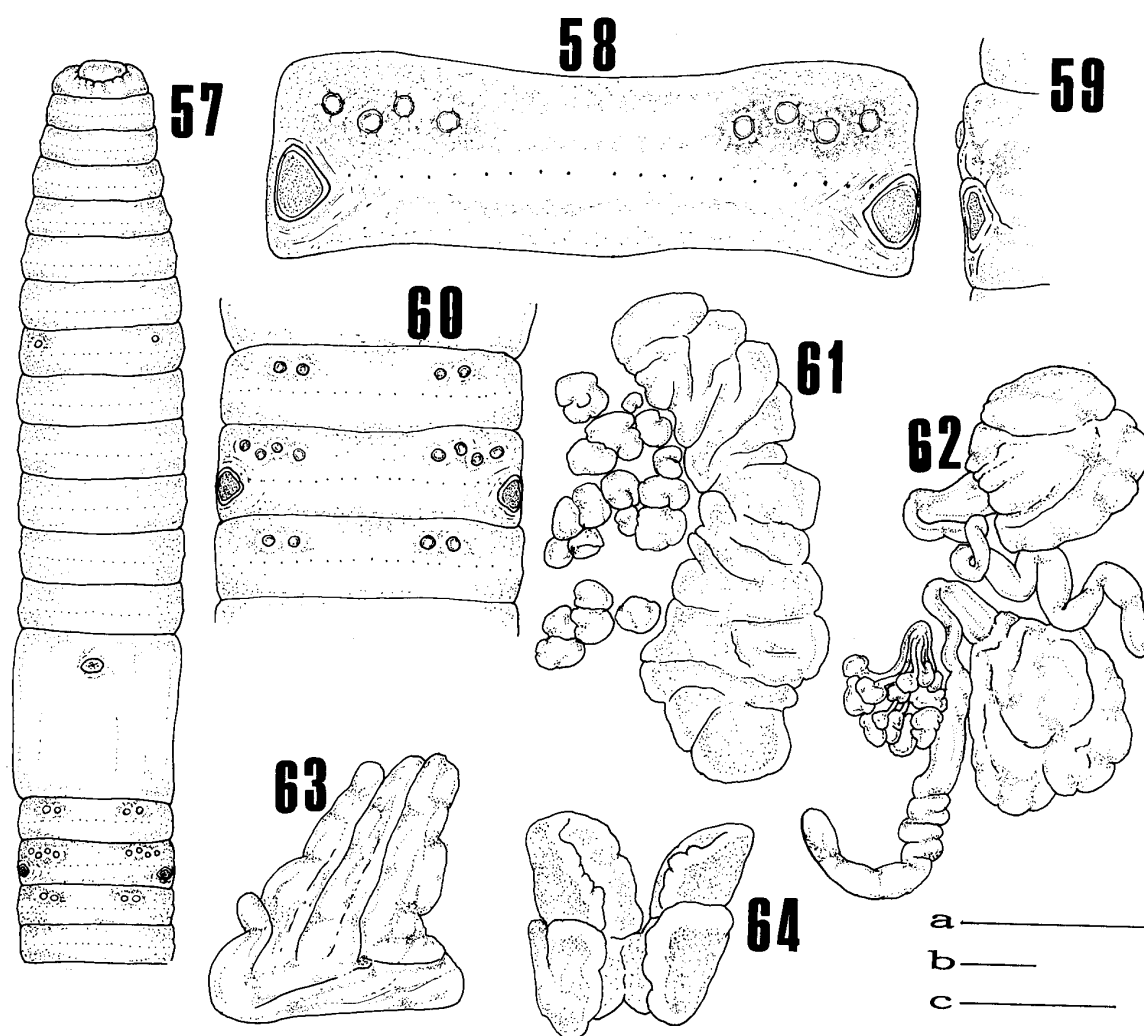
Pheretima silvatica sp. nov.

[New Japanese name: Daibosatsu-mimizu]

(Figs. 57–64, Table 1)

Description. Body. Length 60–80 mm, width 4.0–5.8 mm. Number of segments 69–93. Reddish brown dorsally, greyish white ventrally.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings consisting of genital papillae, paired presetal on segment VIII, occasionally



Figs. 57–64. *Pheretima silvatica* sp. nov. Holotype (NSMT-An 251). 57: Ventral view of anterior body. 58: Male pores and genital papillae on segment XVIII. 59: Lateral view of segment XVIII. 60: Ventral view of male pores and genital papillae. 61: Prostate gland and capsulogenous glands (simple duct type). 62: Spermathecae and capsulogenous glands (complex duct type). 63: Intestinal caecum. 64: Dorsal view of seminal vesicles. (Scale bars. a; 5 mm for 57, 64, b; 1 mm for 60–63, c; 1 mm for 58–59)

on segment VII and 2–4 pairs presetal on segments XVII–XIX, occasionally on segment XX. Male pores simple, on medium-sized porophores, superficial on segment XVIII, separated by a distance of ca. $1/3$ body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12. Clitellum including segments XIV–XVI. Setal number 50–54 in segment VII, 50–58 in segment XX.

Internal characters. Manicate intestinal caeca each with 4–6 diverticula, originating in segment XXVII, extending anteriorly for 3–4 segments. Intestine begins in XV. Genital glands consisting of capsulogenous glands, with stalked glands associated with genital papillae, being two types; in one type, one genital papillae corresponding to one simple duct bearing a simple capsulogenous gland; and in an other type, one genital papillae corresponding to one complex duct bearing several capsulogenous glands. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate 10/11/12/13/14. Two pairs of spermathecae on segments VII–VIII. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum a long convoluted and a duct. Seminal vesicle large, extending on segments X–XI. Prostata very large, extending on segments XVII–XXII, corresponding to male pore.

Material examined. Holotype (NSMT-An 251) and 2 paratypes (NSMT-An 252): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Daibosatsu-tôge, 26–VII–1981, K. Ishizuka. Other specimens examined: 2 exs. Mt. Daibosatsu-tôge, 6–VIII–1980; 4 exs. with same data as type series.

Remarks. The new species resembles *Pheretima limpila* Chen, 1938, but is distinguishable from the latter species by (1) two pairs of spermathecal pores, (2) the long twisted tubular diverticulum, (3) the manicate intestinal caeca, and (4) genital markings which are paired presetal on segment VIII and 2–4 pairs presetal on seg-

Table 1. The number, the arrangement and position of genital papillae of *Pheretima silvatica* sp. nov. Ten individuals from Mt. Daibosatsu-tôge.

No.	Preclitellar		Postclitellar			
	VII	VIII	XVII	XVIII	XIX	XX
1	0	1 pair	3 pairs	4 pairs	2 pairs	0
2	0	1 pair	2 pairs	4 pairs	2 pairs	0
3	1 pair	1 pair	3 pairs	4 pairs	3 pairs	one side
4	1 pair	1 pair	2 pairs	3 pairs	2 pairs	0
5	0	1 pair	3 pairs	3 pairs	3 pairs	0
6	0	1 pair	3 pairs	2 pairs	3 pairs	0
7	0	1 pair	2 pairs	2 pairs	2 pairs	0
8	0	1 pair	2 pairs	3 pairs	2 pairs	0
9	0	1 pair	2 pairs	3 pairs	3 pairs	1 pair
10	0	1 pair	0	3 pairs	2 pairs	one side

ment XVII–XIX. The new species is distinguishable from all the other congeneric species by the number, arrangement and position of genital papillae.

***Pheretima surcata* sp. nov.**

[New Japanese name: Keikoku-mimizu]

(Figs. 65–74)

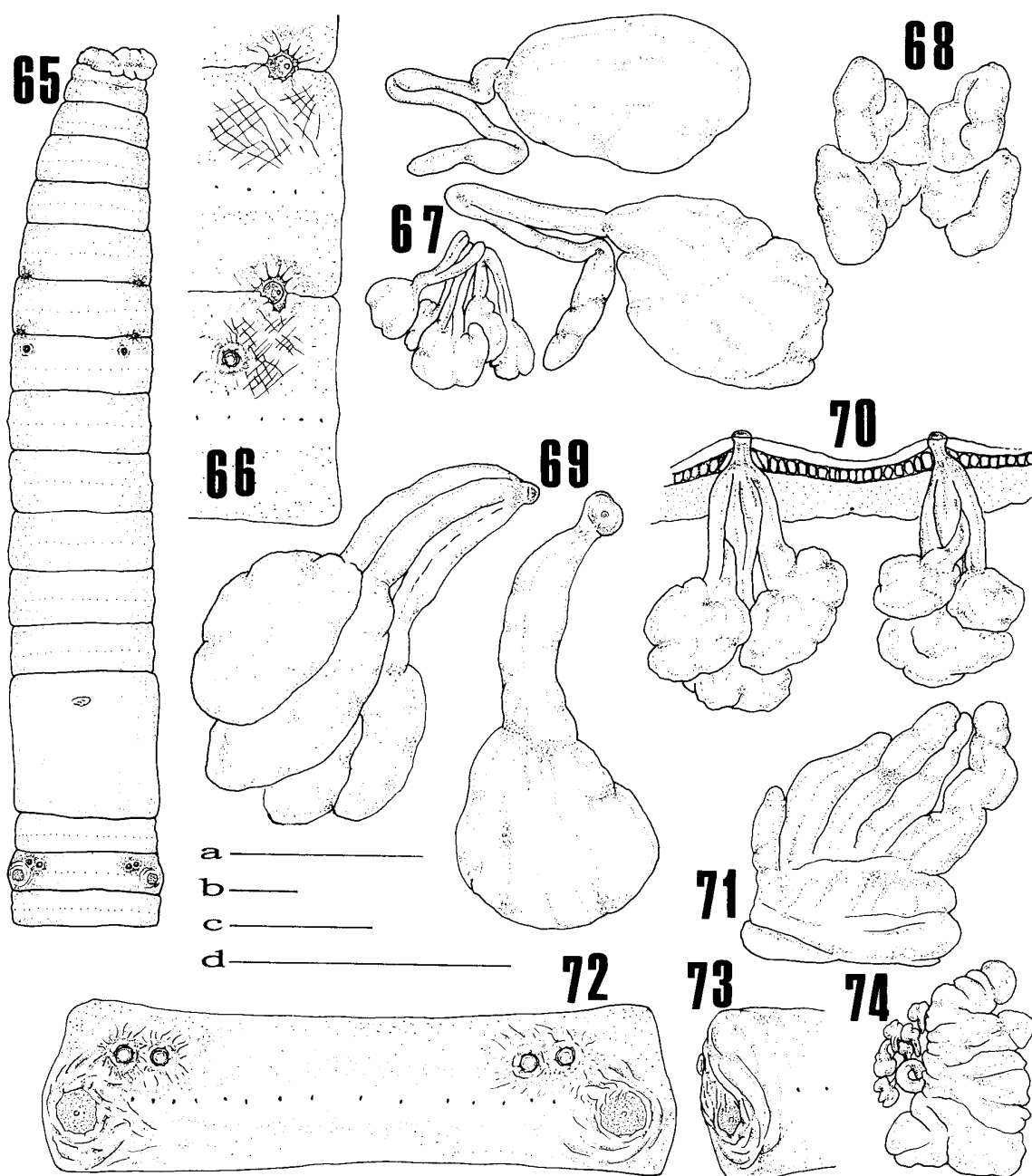
Description. Body. Length 60–125 mm, width 4.0–5.0 mm. Number of segments 54–99. Reddish brown dorsally, greyish white ventrally.

External characters. Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings consisting of genital papillae, paired, presetal on segments VII–VIII and presetal adjacent male pores on segment XVIII. Male pores simple, on medium-sized porophores, superficial on segment XVIII, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 47–48 in segment VII, 51–56 in segment XX.

Internal characters. Maniccate intestinal caeca each with 4–6 diverticula, originating in segment XXVII, extending anteriorly for 4–5 segments. Intestine begins in XV. Genital glands consisting of capsulogenous glands, large, well developed, with stalked glands associated with genital papillae, being two types; in one type, one simple duct bearing a capsulogenous gland corresponding to the one genital papillae, and in an other type, one complex duct bearing several capsulogenous glands corresponding to one genital papillae. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Two pairs of spermathecae on segments VII–VIII, each single. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum consisting of a narrow duct and a distal sausage like swelling. Seminal vesicles large, extending to dorsal line on segments XI–XII. Prostata on segments XVI–XX, corresponding to male pore.

Material examined. Holotype (NSMT-An 253) and 5 paratypes (NSMT-An 254): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Nippara Valley, 14–IX–1985, K. Ishizuka. Other specimens examined: 10 exs. with same data as type series; 24 exs. Ohkumotori Valley, 8–VIII–1981. All the specimens were collected by the author.

Remarks. The new species resembles *Pheretima irregularis* Goto et Hatai 1898, but is distinguishable from the latter species by that (1) the genital papillae and paired presetal are on the segments VII–VIII and two paired presetal are adjacent to the male pores on segment XVIII, and (2) the genital glands are consisted of two types; in one type, one simple duct bearing a capsulogenous gland is corresponding to the one genital papillae and in one other, one complex duct type bearing several capsulogenous glands is corresponding to the one genital papillae and genital papil-



Figs. 65–74. *Pheretima surcata* sp. nov. Holotype (NSMT-An 253). 65: Ventral view of anterior body. 66: Spermathecal pores and genital papillae one side on segments V–VII (ventral view). 67: Spermathecae and capsulogenous glands (complex duct type). 68: Dorsal view of seminal vesicles. 69: Capsulogenous glands (simple duct type) and capsulogenous glands (complex duct type). 70: A cross sectional view in segment XVIII. Genital glands associated with genital papillae. 71: Intestinal caecum. 72: Male pores and genital papillae on segment XVIII. 73: Lateral view of segment XVIII. 74: Prostate gland and capsulogenous glands. (Scale bars. a; 5 mm for 65, 68, 74, b; 1 mm for 67, 71, c; 1 mm for 66, 70, 72–73, d; 1 mm for 69)

lae are minute, but the genital glands connected are large.

***Pheretima verticosa* sp. nov.**

[New Japanese name: Minedani-mimizu]

(Figs. 75–83)

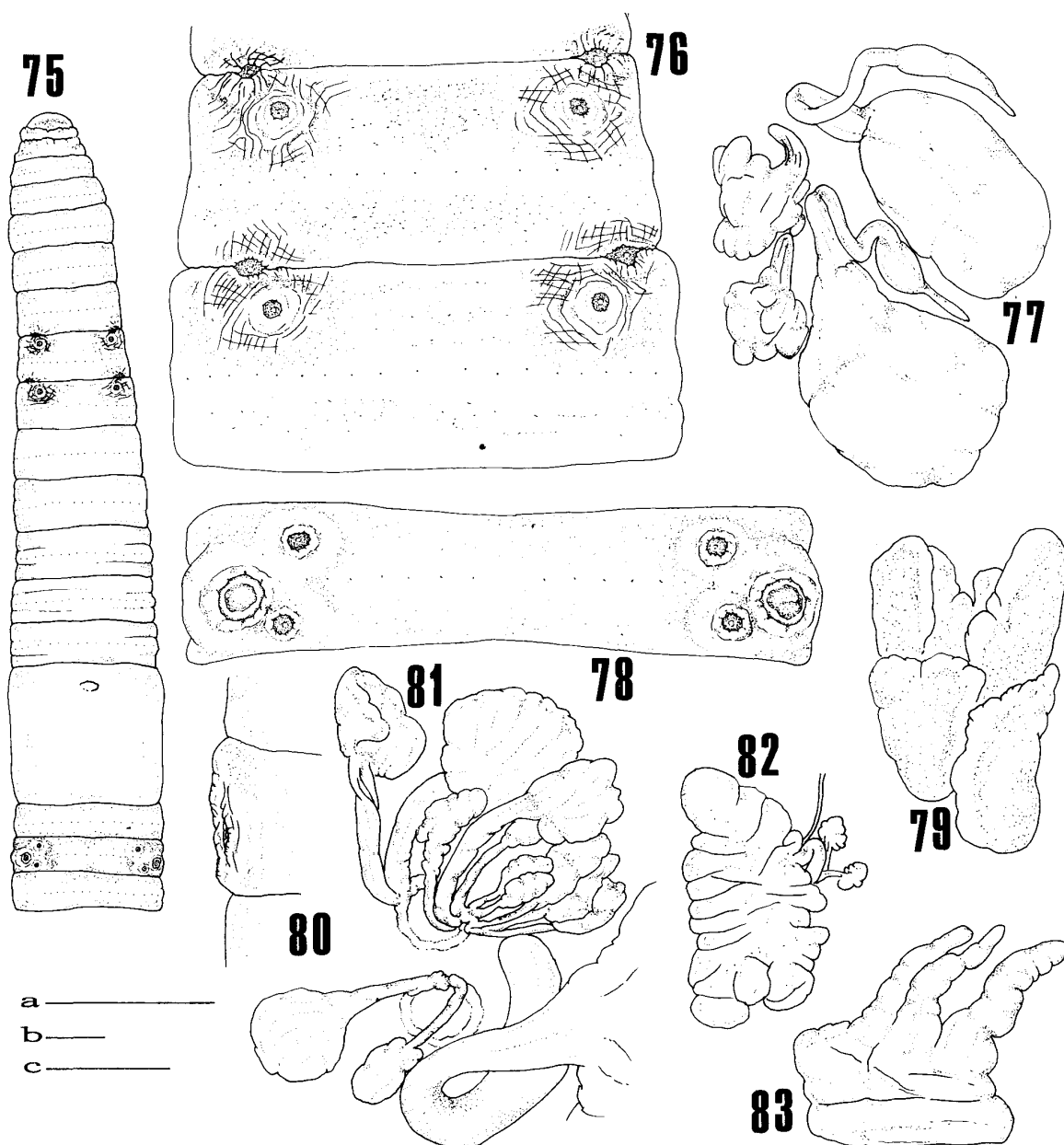
Description. Body. Length 70–100 mm, width 3.5–5.2 mm. Number of segments 80–90. Reddish brown dorsally, yellowish grey ventrally.

External characters. Two pairs of spermathecal pores large, situated in furrows 6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings small, genital papillae depressed, paired presetal on segments VII–VIII and two paired pre-and postsetal on segment XVIII, adjacent male pore on segment XVIII. Male pores simple, on medium-sized porophores, superficial on segment XVIII, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 36–40 in segment VII, 50–54 in segment XX.

Internal characters. Maniculate intestinal caeca each with 3–4 diverticula, originating in segment XXVII, extending anteriorly for 3–4 segments. Intestine begins in XVI. Genital glands consisting of capsulogenous gland (simple duct type), large, well developed, with stalked gland associated with genital papillae, being two types; in one type, one large capsulogenous glands corresponding to the one genital papillae, paired, presetal on VII–VIII, and in an other type, several pieces of large capsulogenous glands of male pore fasciculated along margin of small circular genital papillae. Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Two pairs of spermathecae large on segments VII–VIII extending on segments VI–IX and VIII–X. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum consisting of a narrow duct and a distal part guinea pepper-shape. Seminal vesicle large, well developed, extending on segments X–XV. Prostata on segments XVI–XXIII, corresponding to male pore.

Material examined. Holotype (NSMT-An 255) and 2 paratypes (NSMT-An 256): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mizune Valley, 7–IX–1983, K. Ishizuka. Other specimens examined: 1 ex. with same data as type series; 1 ex. Mt. Kumotori, 6–IX–1983, K. Ishizuka.

Remarks. The new species is distinguishable from all the other congeneric species by that (1) the genital papillae are depressed, small and circular in shape, and (2) Several pieces of capsulogenous gland (simple duct type) of male pore are fasciculated, along the margin of the small circular genital papillae.



Figs. 75–83. *Pheretima verticosa* sp. nov. Holotype (NSMT-An 255). 75: Ventral view of anterior body. 76: Spermathecal pores and genital papillae on segments VI–VIII, ventral view. 77: Spermathecae and capsulogenous glands (simple duct type). 78: Male pores and genital papillae on segment XVIII. 79: Dorsal view of seminal vesicles. 80: Lateral view of segment XVIII. 81: Capsulogenous glands (simple duct type) and prostate gland with duct. 82: Prostate gland and capsulogenous glands. 83: Intestinal caecum. (Scale bars. a; 5 mm for 75, 79, b; 1 mm for 77, 82–83, c; 1 mm for 76, 78, 80–81)

Pheretima florea sp. nov.

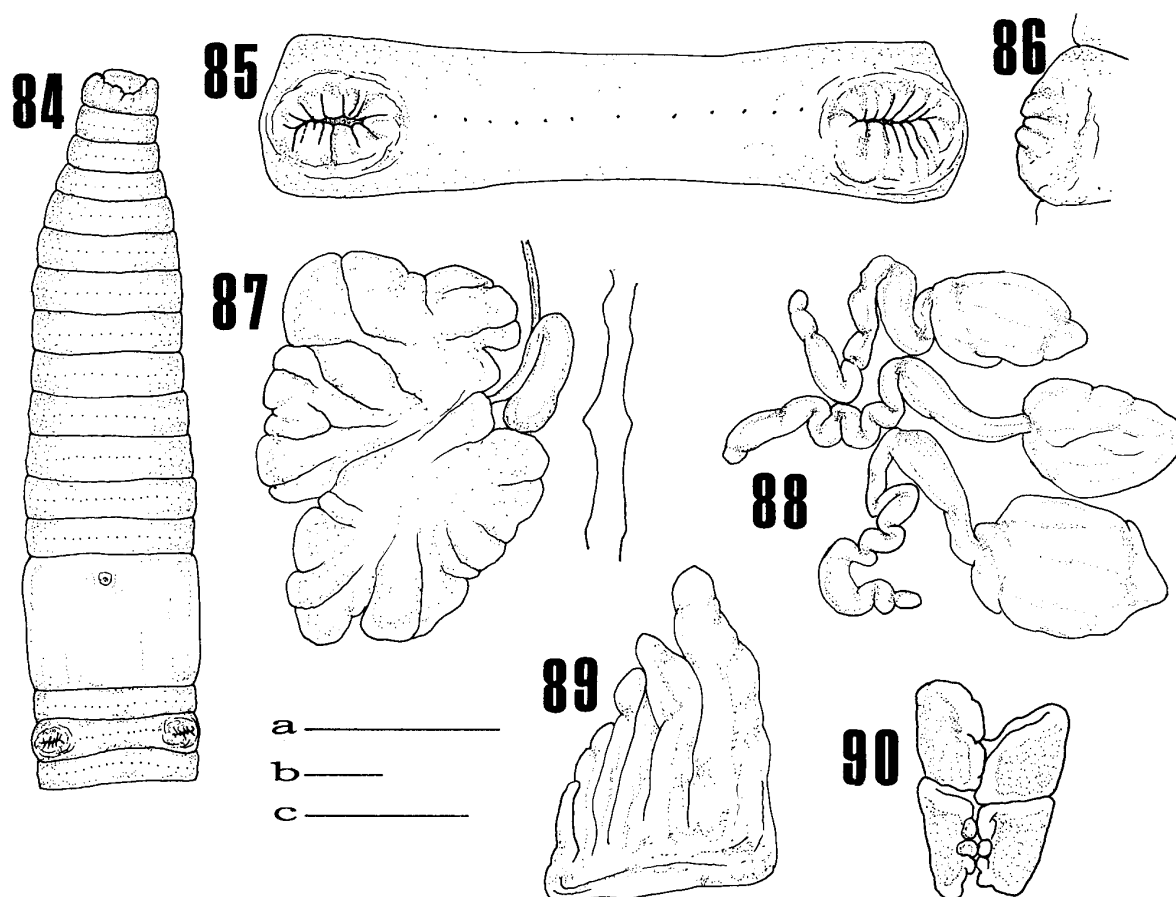
[New Japanese name: kogata-mimizu]

(Figs. 84–90)

Description. Body. Length 60–80 mm, width 3.0–3.3 mm. Number of segments 73–90. Light brown dorsally, greyish white ventrally.

External characters. Three pairs of spermathecal pores situated in furrows 5/6/7/8 in ventro-lateral sides, separated by a distance of ca. 1/2 body circumference. Genital marking absent. Male pore large, flower-shaped porophores, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Setal number 36–44 in segment VII, 46–48 in segment XX. Clitellum including segments XIV–XVI.

Internal characters. Manicate intestinal caeca each with 6 diverticula, originating in segment XXVII, extending anteriorly for 4–5 segments. Intestine begins in XV.



Figs. 84–90. *Pheretima florea* sp. nov. Holotype (NSMT-An 257). 84: Ventral view of anterior body. 85: Male pores on segment XVIII. 86: Lateral view of segment XVIII. 87: Prostate gland. 88: Spermathecae. 89: Intestinal caecum. 90: Dorsal view of seminal vesicles. (Scale bars. a; 5 mm for 84, 90, b; 1 mm for 87–89, c; 1 mm for 85–86)

Septa absent in 8/9/10, slightly thickened in 5/6/7/8, delicate in 10/11/12/13/14. Genital gland absent. Spermathecae large, three pairs in segments VI–VIII. Ampulla consisting of a shovel-shaped pouch and a duct. Diverticulum long convoluted tube. Seminal vesicle very large, extending on segments XI–XII. Prostata large, extending on segments XVII–XXII, corresponding to male pore.

Material examined. Holotype (NSMT-An 257) and 3 paratypes (NSMT-An 258): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Daibosatsu-tôge, 6–VIII–1980, K. Ishizuka. Other specimens examined: 1 ex. with same data as type series; 2 exs. Mt. Daibosatsu-tôge, 26–VII–1981, K. Ishizuka.

Remarks. The new species closely resembles *Pheretima commnissima* (Goto et Hatai, 1899), but is distinguishable from the latter species by (1) the small body length 60–70 mm (150–250 mm in *Ph. commnissima*), (2) the shovel-shaped ampulla (globular in *Ph. commnissima*) and (3) the distribution mountain district (plain district in *Ph. commnissima*).

***Pheretima striata* sp. nov.**

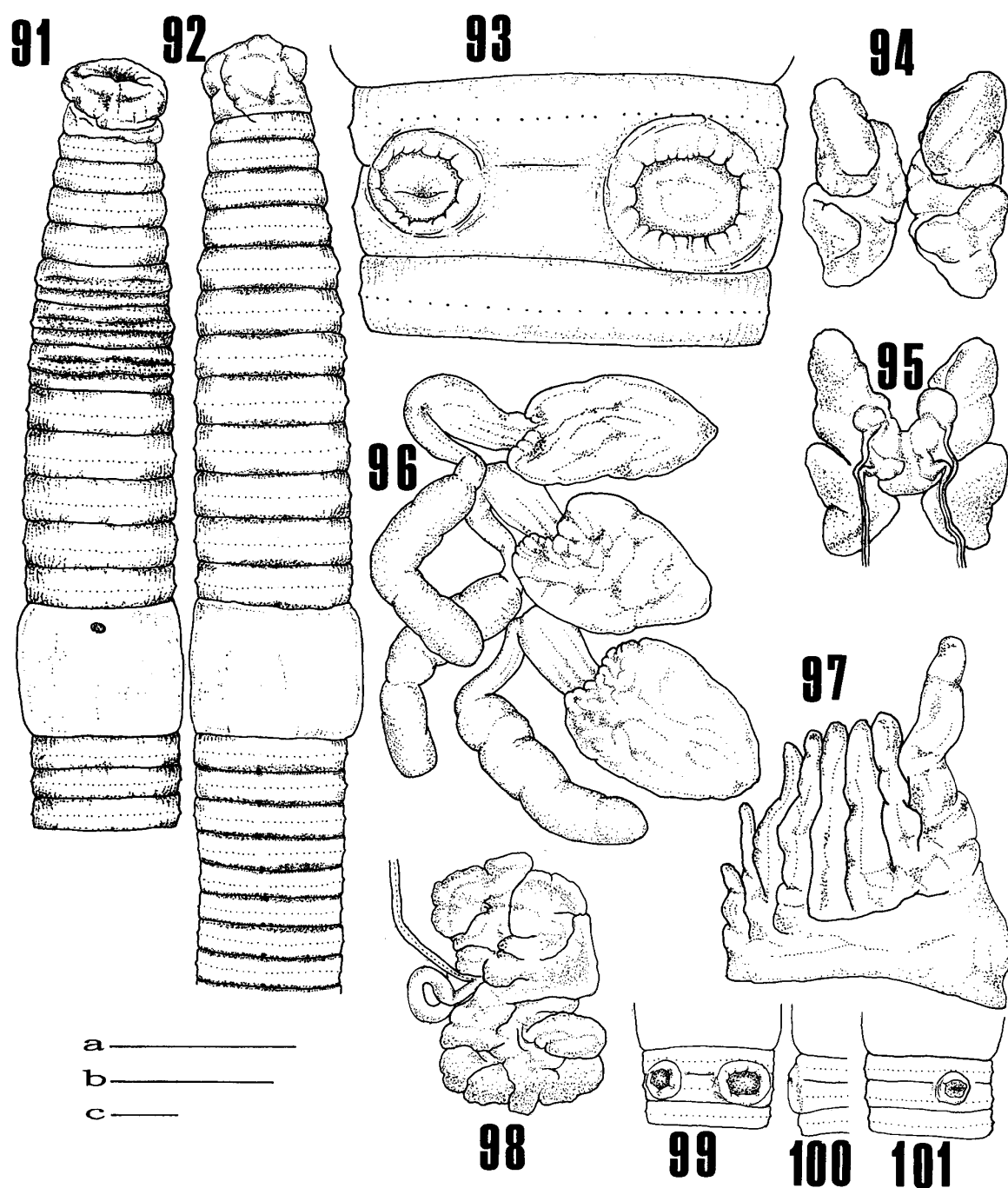
[New Japanese name: Hososuji-mimizu]

(Figs. 91–101)

Description. Body. Length 110–165 mm, width 5.0–8.0 mm. Number of segments 90–105. Yellowish brown dorsally and ventrally, a reddish brown band in intersegmental furrows showing, therefore a pin-striped pattern in appearance; each of segments VI–VIII bi- or triannulate ventrally; flesh-color in life.

External characters. Three pairs of spermathecal pores situated in furrows 5/6/7/8 in ventro-lateral sides, separated by a distance of ca. 2/5 body circumference. Genital marking absent. External markings present, deep-grooves (lines like) and flesh-colored ventrally on segments VI–VIII. Male pore rare, found only in 3% of examined specimens, penes stubby and large, the apertures of which extend from furrow 17/18 to the postsetal region of segment XVIII, separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 55–60 in segment VII, 58–65 in segment XX.

Internal characters. Manicate intestinal caeca each with 6–9 diverticula, originating in segment XXVII, extending anteriorly to segment 4. Intestine begins in XV. Genital gland absent. Septa absent in 8/9/10, thickened in 5/6/7/8, slightly thickened in 10/11/12/13/14. Three pairs of spermathecae on segments VI–VIII, each paired. Ampulla consisting of a shovel-shaped pouch and a stout duct. Diverticulum consisting of a narrow duct and a distal sausage-like swelling. Seminal vesicles large, extending to dorsal line on segments XI–XII. Prostata on segments XVII–XX, corresponding to the male pores, found only in specimens possessing male pores.



Figs. 91–101. *Pheretima striata* sp. nov. 91–92, 94–98: Holotype (NSMT-An 259), 93, 99–101: Paratype (NSMT-An 260). 91: Ventral view of anterior body. 92: Dorsal view of anterior body. 93, 99: Male pores on segment XVIII. 94: Dorsal view of seminal vesicles. 95: Ventral view of seminal vesicles. 96: Spermathecae. 97: Intestinal caecum. 98: Prostate gland. 100: Lateral view of segment XVIII (in another individual). 101: Ventral view of on segment XVIII (in another individual). (Scale bars. a; 10 mm for 91–92, 99–101, b; 1 mm for 94–95, c; 1 mm for 93, 96–98)

Material examined. Holotype (NSMT-An 259) and 5 paratypes (NSMT-An 260): From litter and surface soil under a mixed forest of evergreen and deciduous trees, Mt. Mitake, 7–VII–1988, K. Ishizuka. 1 paratype: 1 ex. Hino City, 1–VII–1984, K. Ishizuka. Other specimens examined: 13 exs. Institute for the Nature Study, National Science Museum, 18–VII–1985; 6 exs. with same data as the holotype; 1 ex. Okutama-cho, 3–VIII–1983; 2 exs. Itsukaichi City, 30–VII–1985; 5 exs. with same data as the paratype. All the specimens were collected by the author.

Remarks. The new species is similar in body size and in striped pattern to *Pheretima vittata* (Goto et Hatai, 1898), but is distinguishable from the latter species by (1) pin-striped pattern of intersegmental furrows showing, (2) three pairs of spermathecal pores, (3) absence of genital papillae, and (4) flesh color on segments VI–VIII, where the deep grooves are arranged along its setal line. These VI–VIII segments and pin-striped pattern are very conspicuous and make the character of the new species.

Key to the species of the genus *Pheretima* s. lat. with manicate intestinal caeca.

1. Copulatory pouches present *Ph. shmardae* (Horst)
- Copulatory pouches absent 2
2. Male pore absent 3
- Male pore present 8
3. Spermathecal pore one pair (genital marking absent) *Ph. conjugata* sp. nov.
- Spermathecal pore two pairs 4
- Spermathecal pore three pairs 7
4. Genital marking absent *Ph. irregularis* (Goto et Hatai) (in part)
- Genital marking present 5
5. Genital markings situated posterior to clitellum [cluster (several to a dozen pieces, genital papillae)] on segment XVIII *Ph. aokii* sp. nov.
- Genital markings situated anterior to clitellum 6
6. Genital markings in a cluster (a patch) on segment VII or VII–VIII
..... *Ph. hilgendorfi* (Michaelson) (in part)
- Genital markings arranged in a row (on setal line) on segment VII, (dorsal surface of body showing a striped pattern) *Ph. vittata* (Goto et Hatai) (in part)
7. Deep grooves ventrally in flesh-colored part on segments VI–VIII, (dorsal surface of body showing a striped pattern) *Ph. striata* sp. nov. (in part)
- Brown-colored patches ventrally on segments VI–VIII
..... *Ph. agrestis* (Goto et Hatai) (in part)
8. External markings absent 9
- External markings present 19
9. Spermathecal pore two pairs 10
- Spermathecal pore three pairs 18

10. Genital markings situated posterior to clitellum 11
- Genital markings situated anterior and posterior to clitellum..... 12
11. Genital markings situated on and covering male pore
..... *Ph. okutamaensis* sp. nov.
- Genital markings situated close to male pore and similar in shape and size to the
latter *Ph. bigibberosa* sp. nov.
12. Genital markings forming a patch (in a cluster) 13
- Genital markings 1–4 pieces (in a row) 14
13. Genital markings forming a patch (in a cluster) on segment VII or VII–VIII.....
..... *Ph. hilgendorfi* (Michaelsen) (in part)
- Genital markings forming clusters (spot shape) on segment XVIII or XVIII–XIX
and 1–2 pairs on segments VIII–IX..... *Ph. bimaculata* sp. nov.
14. Genital glands complex duct type 15
- Genital glands simple duct type 17
15. Spermathecae (ampullae) saccular-shape (genital markings in a row presetal on
segments XVII–XIX and one pair on segment VIII) *Ph. silvatica* sp. nov.
- Spermathecae (ampullae) shovel-shape 16
16. Genital markings in a row pre-and postsetal on segment XVIII.....
..... *Ph. surcata* sp. nov.
- Genital markings in a row only presetal on segment XVIII ... *Ph. verticosa* sp. nov.
17. Genital markings in a row along setal line on segment XVIII (dorsal surface of
body showing a striped pattern) *Ph. vittata* (Goto et Hatai) (in part)
- Genital markings one or two pair on segments VII–VIII and XVIII
..... *Ph. irregularis* (Goto et Hatai) (in part)
18. Body small (length 60–70 mm) *Ph. florea* sp. nov.
- Body large (length 150–250 mm) *Ph. communissima* (Goto et Hatai)
19. Brown-colored patches absent, (deep grooves ventrally in fresh-colored patches
on segments VI–VIII, dorsal surface of body showing a striped pattern)
..... *Ph. striata* sp. nov.
- Brown-colored patches present..... 20
20. Genital markings absent, (brown-colored patches ventrally on segments VI–VIII)
..... *Ph. agrestis* (Goto et Hatai) (in part)
- Genital markings present, (brown-colored patches ventrally on segments VII–
VIII, genital markings 5–15 pieces in two rows medially and 1–2 pieces laterally
on each side)..... *Ph. purpurata* sp. nov.

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